

REMARKS

I. Introduction

Claims 14 to 31 are pending in the present application. In view of the following remarks, it is respectfully submitted that all of the presently pending claims are allowable, and reconsideration is respectfully requested.

II. Rejection of Claims 14, 16 to 22, 27, 29, and 30 Under 35 U.S.C. § 103(a)

Claims 14, 16 to 22, 27, 29, and 30 were rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of allegedly admitted prior art ("AAPA"), U.S. Patent No. 3,354,646 ("Walter et al."), "Highly Selective Etching of Si₃N₄ to SiO₂ Employing Fluorine and Chlorine Atoms Generated by Microwave Discharge" ("Suto et al."), and U.S. Patent Application Publication No. 2001/0007275 ("Yanagisawa et al."). It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not render unpatentable these claims for at least the following reasons.

As an initial matter, Applicant respectfully maintains the traversal of any and all assertions of inherency contained in the Office Action. As regards the alleged inherency of chlorine trifluoride in the apparatus of Suto et al., the apparatus and base gases disclosed in Walter et al. differ substantially from the disclosure of Suto et al. Thus, the purported generation of chlorine trifluoride in Walter et al. does not in any way establish or support any contention that chlorine trifluoride would necessarily be generated under the conditions disclosed in Suto et al. Nonetheless, the present rejection is deficient for at least the following additional reasons.

Regarding the combination of references relied upon by the Examiner, Applicant respectfully disagrees with the Examiner's contention at page 8 of the Final Office Action that AAPA "teaches a method and apparatus that discloses benefit of using ClF₃ for etching silicon substrates." In this regard, the portion of the Specification (pag 1, lines 10 to 20) cited by the Examiner does not disclose any apparatus. Thus, the Examiner's contention that it would have been obvious to modify an alleged apparatus of AAPA in view of the other cited references is untenable.

Applicant also respectfully disagrees with the Examiner's contention at page 9 of the Final Office Action that "it would have been obvious to one of ordinary skills [sic] in the art at the time of the invention to regulate the process parameters

like pressure and flow rates of first and second gases as taught by Walter et al. in the apparatus of admitted prior art to obtain enhanced etching rate of substrates.” Contrary to this contention, Walter et al. discloses an apparatus with a single tank holding the gas composed of one or more substances. Col. 2, lines 49 to 55. Thus, any flow control would only apply to the single gas contained in the tank. As such, Walter et al. does not disclose, or even suggest providing first and second gases to a plasma reactor, or regulating flow rates of first and second gases provided to a plasma reactor. Moreover, Walter et al. makes clear that the flow rate is inconsequential except to the extent that it may affect the glow discharge. See col. 3, lines 4 to 6.

Since Walter et al. teaches only a single gas supply tank, any mention of stoichiometric proportions of fluorine and chlorine atoms necessarily refers to the proportion of these atoms present in the single source of reactant gas. Thus, as regards stoichiometric ratios, Walter et al. *at most* teaches providing a stoichiometric ratio of atoms in a single supply gas for formulation of chlorine pentafluoride. Furthermore, since Walter et al. discloses chlorine trifluoride as a readily available reactant gas, it is unclear why Walter et al. would lead one of ordinary skill in the art to modify the apparatus of Walter et al. to be stoichiometrically optimized to generate chlorine trifluoride.

Regarding Suto et al., it is noted that the gases supplied to the microwave tube are converted largely to radical F and Cl atoms, which then react with either the silicon substrate or chlorine gas introduced by a separate inlet into the process chamber. Since the apparatus of Suto et al. is arranged such that a substantial portion of the atoms interact—after leaving the microwave tube—with either the silicon substrate or the separately introduced chlorine gas, there would be no apparent reason to provide the NF_3 and Cl_2 gas into the microwave tube in any particular stoichiometric ratio.

Further regarding Suto et al., Applicant disagrees with the assertion at page 10 of the Final Office Action that “[s]ince Suto teaches production of interhalogen ClF during the process, few molecules of ClF_3 would also be produced during the process, considering the teaching of Walter et al. that ClF_3 could be produced under glow discharge conditions.” Further to the discussion of inherency set forth above, whether or not chlorine trichloride “could” be produced in the apparatus of Walter does not in any way establish that chlorine trifluoride would

necessarily be produced. As further regards claim 19, even if Suto et al. disclosed the formation of some minute amount of chlorine trifluoride—which Suto et al. does not—there would still be no teaching or suggestion of etching a silicone substrate in the process chamber using the hypothetical chlorine trifluoride gas.

Yanagisawa et al. also relates to converting gases into radicals that act directly on a substrate. See, e.g., para. [0004]. As was the case with Suto et al., there would be no apparent reason to provide the supply gases of Yanagisawa et al. into the microwave generator according to any particular stoichiometric ratio.

As indicated above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose, or even suggest, a gas supply means including a first mass flow regulator configured to regulate the first gas to a first flow rate to the plasma reactor, and a second mass flow regulator configured to regulate the second gas to a second flow rate to the plasma reactor, wherein the first flow regulator and the second flow regulator are configured to regulate the respective first and second flow rates to provide an ideal stoichiometric conversion of the first gas and the second gas to chlorine trifluoride, as recited in claim 14.

Likewise, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. do not disclose, or even suggest, supplying to a plasma reactor a first gas and a second gas, which react with one another under the influence of a high-density plasma in the plasma reactor, forming chlorine trifluoride, a ratio of the amount of the first gas and the amount of the second gas being selected to achieve an ideal stoichiometric conversion to chlorine trifluoride, as recited in claim 20.

The combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. also does not disclose or even suggest supplying to a plasma reactor a first gas according to a first gas flow rate, supplying to the plasma reactor a second gas according to a second gas flow rate, wherein the first gas and the second gas react with one another under the influence of the high-density plasma to form chlorine trifluoride in the plasma reactor, and a ratio of the first gas flow to the second gas flow is selected to achieve an ideal stoichiometric conversion to chlorine trifluoride as recited in claim 27.

As further indicated above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose, or even suggest, supplying to a plasma reactor a first gas and a second gas, reacting the first gas and the second gas under the influence of the high-density plasma to form chlorine trifluoride in the

plasma reactor; and transferring the formed chlorine trifluoride to a process chamber assigned to the plasma reactor, and etching a silicone substrate in the process chamber using the formed chlorine trifluoride as an etching gas, as recited in claim 29.

As indicated above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose or suggest all of the features of any of claims 14, 20, 27, and 29. As such, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not render unpatentable any of claims 14, 20, 27, and 29, or any of claims 14, 16 to 19, 21, 22 and 30, each of which depends from one of claims 14, 20, and 29. Accordingly, withdrawal of this rejection is respectfully requested.

III. Rejection of Claim 15 Under 35 U.S.C. § 103(a)

Claim 15 was rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and U.S. Patent No. 5,756,400 ("Ye et al."). It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. does not render unpatentable claim 15 for at least the following reasons.

Claim 15 depends from claim 14 and therefore includes all of the features recited in claim 14. As indicated above, the combination of AAPA, Walter et al., Suto et al. and Yanagisawa et al. does not disclose or suggest all of the features recited in claim 14. Ye et al. is not relied upon as disclosing the features of claim 14 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al. and Yanagisawa et al. Indeed, Ye et al. does not disclose, or even suggest, the features of claim 14 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al.

As indicated above, the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. does not disclose or suggest all of the features of claim 15. As such, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al. and Ye et al. does not render unpatentable claim 15.

In view of the foregoing, withdrawal of this rejection is respectfully requested.

IV. Rejection of Claims 23 and 26 Under 35 U.S.C. § 103(a)

Claims 23 and 26 were rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and U.S. Patent No. 6,136,214 (“Mori et al.”). It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Mori et al. does not render unpatentable these claims for at least the following reasons.

Claims 23 and 26 depend from claim 20 and therefore include all of the features recited in claim 20. As more fully set forth above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose, or even suggest, all of the features recited in claim 20. Mori et al. is not relied upon for disclosing or suggesting the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. Indeed, Mori et al. does not disclose, or even suggest, the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al.

In view of the foregoing, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Mori et al. does not render unpatentable claims 23 and 26. Accordingly, withdrawal of this rejection is respectfully requested.

V. Rejection of Claim 24 Under 35 U.S.C. § 103(a)

Claim 24 was rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and U.S. Patent No. 6,953,557 (“Ikeda et al.”). It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ikeda et al. does not render unpatentable claim 24 for at least the following reasons.

Claim 24 depends from claim 20 and therefore includes all of the features recited in claim 20. As more fully set forth above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose, or even suggest, all of the features recited in claim 20. Ikeda et al. is not relied upon for disclosing or suggesting the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. Indeed, Ikeda et al. does not disclose, or even suggest, the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al.

In view of the foregoing, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ikeda et al. does not render unpatentable claim 24. Accordingly, withdrawal of the present rejection is respectfully requested.

VI. Rejection of Claim 25 Under 35 U.S.C. § 103(a)

Claim 25 was rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. does not render unpatentable claim 25 for at least the following reasons.

Claim 25 depends from claim 20 and therefore includes all of the features recited in claim 20. As indicated above, the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. does not disclose or suggest all of the features recited in claim 20. Ye et al. is not relied upon as disclosing the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al. Indeed, Ye et al. does not disclose, or even suggest, the features of claim 20 not disclosed or suggested by the combination of AAPA, Walter et al., Suto et al., and Yanagisawa et al.

As indicated above, the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. does not disclose or suggest all of the features of claim 25. As such, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., Yanagisawa et al., and Ye et al. does not render unpatentable claim 25.

In view of the foregoing, withdrawal of this rejection is respectfully requested.

VII. Rejection of Claims 28 and 31 Under 35 U.S.C. § 103(a)

Claims 28 and 31 were rejected under 35 U.S.C. § 103(a) as unpatentable over the combination of AAPA, Walter et al., Suto et al., and U.S. Patent No. 5,641,380 ("Yamazaki et al."). It is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., and Yamazaki et al. does not render unpatentable these claims for at least the following reasons.

Claim 28 depends from claim 27 and therefore includes all of the features recited in claim 27. As more fully set forth above, the combination of AAPA, Walter et al., and Suto et al. does not disclose, or even suggest, all of the features recited in claim 27. Yamazaki et al. is not relied upon as disclosing the features of claim 27 not disclosed or suggested by the combination of AAPA, Walter et al., and Suto et al. Indeed, Yamazaki et al. does not disclose, or even suggest, the features of claim 27 not disclosed or suggested by the combination of AAPA, Walter et al., and Suto et al.

Claim 31 depends from claim 29 and therefore includes all of the features recited in claim 29. As more fully set forth above, the combination of AAPA, Walter et al., and Suto et al. does not disclose, or even suggest, all of the features recited in claim 29. Yamazaki et al. is not relied upon as disclosing the features of claim 29 not disclosed or suggested by the combination of AAPA, Walter et al., and Suto et al. Indeed, Yamazaki et al. does not disclose, or even suggest, the features of claim 29 not disclosed or suggested by the combination of AAPA, Walter et al., and Suto et al.

As indicated above, the combination of AAPA, Walter et al., Suto et al., and Yamazaki et al. does not disclose or suggest all of the features of claims 28 and 31. As such, it is respectfully submitted that the combination of AAPA, Walter et al., Suto et al., and Yamazaki et al. does not render unpatentable claims 28 and 31.

In view of the foregoing, withdrawal of this rejection is respectfully requested.

VIII. Conclusion

It is therefore respectfully submitted that all of the presently pending claims are allowable. All issues raised by the Examiner having been addressed, an early and favorable action on the merits is earnestly solicited.

Respectfully submitted,

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